

Table 3.7-3 Summary of surface water chemistry from surface water monitoring sites

Analytes	Units	No. of analyses	No. of detects	No. of MDL's	Min	Max	Average (3)	Water Quality Criteria (1)	No. of exceedences
Alkalinity as CaCO ₃ ⁽²⁾	mg/L	67	67	0	7.3	326	109.0	20000	60
Ammonia-N ⁽⁴⁾	mg/L	62	11	51	-0.1	1.51	0.37		0
Antimony	mg/L	61	14	47	-0.003	0.018	0.003	none	0
Antimony	mg/L	66	18	48	-0.003	0.016	0.003	none	0
Arsenic	mg/L	75	55	20	-0.003	0.027	0.007	150	0
Arsenic	mg/L	80	61	19	-0.003	0.147	0.012	150	0
Barium ⁽²⁾	mg/L	61	61	0	0.007	0.213	0.045	none	0
Barium ⁽²⁾	mg/L	66	66	0	0.0094	0.565	0.064	none	0
Bismuth	mg/L	61	4	57	-0.02	0.1	0.04		0
Bismuth	mg/L	61	4	57	-0.02	0.2	0.05		0
Cadmium	mg/L	61	10	51	-0.0001	0.0003	0.0001	$\exp\{(mC * \ln(\text{hardness})) + bC\} * CF$	0
Cadmium	mg/L	66	14	52	-0.0001	0.0008	0.0001	$\exp\{(mC * \ln(\text{hardness})) + bC\}$	0
Calcium	mg/L	61	61	0	7.499	237	56.43		0
Calcium	mg/L	66	66	0	7.52	255	57.85		0
Calcium Hardness	mg/L	5	5	0	22.8	619	253		0
Chloride ⁽²⁾	mg/L	66	64	2	-0.2	3.17	0.58	230000	0
Chromium	mg/L	61	0	61	-0.002	-0.002	0.001		0

Table 3.7-3 Summary of surface water chemistry from surface water monitoring sites (cont'd)

Analytes	Units	No. of analyses	No. of detects	No. of MDL's	Min	Max	Average (3)	Water Quality Criteria (1)	No. of exceedences
Chromium	mg/L	66	19	47	-0.001	0.069	0.003		0
Conductance	umhos	75	75	0	37	1900	413		0
Copper	mg/L	61	14	47	-0.003	0.019	0.005	$\exp\{(mC * \ln(\text{hardness}) 1) + bC\} * CF$	
Copper	mg/L	66	18	48	-0.005	0.052	0.008	$\exp\{(mC * \ln(\text{hardness}) 5) + bC\}$	
Cyanide, Total	mg/L	66	0	66	-0.01	-0.01	0.01		0
Cyanide, WAD	mg/L	66	0	66	-0.01	-0.01	0.01		0
Field temperature	Deg C	12	12	0	0.6	4.4	2.1	greater than 13	0
Fluoride	mg/L	66	53	13	-0.04	0.48	0.10		0
Iron ⁽²⁾	mg/L	61	60	1	-0.002	1.23	0.336	none	0
Iron ⁽²⁾	mg/L	66	65	1	-0.01	46.5	2.16	1000	28
Lead	mg/L	61	1	60	-0.002	0.004	0.001	$\exp\{(mC * \ln(\text{hardness}) 1) + bC\} * CF$	
Lead	mg/L	66	5	61	-0.002	0.018	0.001	$\exp\{(mC * \ln(\text{hardness}) 1) + bC\}$	
Magnesium	mg/L	61	61	0	0.91	158	23.2		0
Magnesium	mg/L	66	66	0	0.975	161	23.7		0
Manganese	mg/L	61	59	2	-0.003	1.048	0.094		0
Manganese	mg/L	66	63	3	-0.003	1.06	0.127		0
Mercury	mg/L	61	0	61	-0.0002	-0.0002	0.0001	0.77	0
Mercury	mg/L	66	4	62	-0.0002	0.0028	0.0001	0.91	0
Nickel	mg/L	49	3	46	-0.005	0.035	0.011	$\exp\{(mC * \ln(\text{hardness}) 0) + bC\} * CF$	

Table 3.7-3 Summary of surface water chemistry from surface water monitoring sites (cont'd)

Analytes	Units	No. of analyses	No. of detects	No. of MDL's	Min	Max	Average (3)	Water Quality Criteria (1)	No. of exceedences
Nickel	mg/L	54	8	46	-0.019	0.093	0.020	$\exp\{(mC * \ln(\text{hardness})) + bC\}$	1
Nitrate-N ⁽²⁾	mg/L	66	54	12	-0.01	0.84	0.22	none	0
Nitrite-N	mg/L	61	0	61	-0.01	-0.01	0.01		0
pH	Unit	74	74	0	6	8.2	7.57	6.5-8.5	2
Potassium	mg/L	61	59	2	-0.3	6.7	1.8		0
Potassium	mg/L	66	64	2	-0.3	13.1	2.1		0
Selenium	mg/L	61	4	57	-0.002	0.009	0.002		0
Selenium	mg/L	66	10	56	-0.002	0.011	0.002		0
Silicon	mg/L	61	61	0	2.9	7.4	4.60		0
Silicon	mg/L	61	61	0	2.9	79.5	6.80		0
Silver	mg/L	61	17	44	-0.0001	0.0006	0.0011	none	0
Silver	mg/L	66	22	44	-0.0001	0.0007	0.0010		0
Sodium	mg/L	61	61	0	0.27	4.9	2.3		0
Sodium	mg/L	66	66	0	0.359	6.8	2.5		0
Sulfate	mg/L	66	64	2	-1	790	123		0
Total Dissolved Solids	mg/L	66	66	0	51	1590	310		0
Total Phosphate-P	mg/L	66	17	49	-0.01	1.43	0.07		0
Total Solids	mg/L	49	49	0	66	2800	457		0
Total Suspended Solids	mg/L	66	47	19	-1	1500	48		0
Turbidity	NTU	67	67	0	0.1	180	6.4		0

Table 3.7-3 Summary of surface water chemistry from surface water monitoring sites (cont'd)

Analytes	Units	No. of analyses	No. of detects	No. of MDL's	Min	Max	Average (3)	Water Quality Criteria (1)	No. of exceedences
Zinc	mg/L	61	15	46	-0.003	0.044	0.007	$\exp\{(mC * \ln(\text{hardness})) + bC\} * CF$	0
Zinc	mg/L	66	12	54	-0.004	0.099	0.012	$\exp\{(mC * \ln(\text{hardness})) + bC\}$	0
Benzene	ug/L	14	0	14	-0.2	-0.2	0.1		0
Chlorobenzene	ug/L	5	0	5	-0.2	-0.2	0.1		0
1,2-Dichlorobenzene	ug/L	5	0	5	-0.2	-0.2	0.16		0
1,3-Dichlorobenzene	ug/L	5	0	5	-0.2	-0.2	0.16		0
1,4-Dichlorobenzene	ug/L	5	0	5	-0.2	-0.2	0.16		0
Ethylbenzene	ug/L	14	0	14	-0.2	-0.2	0.1		0
Toluene	ug/L	14	2	12	-0.3	0.45	0.18		0
Xylenes	ug/L	14	0	14	-0.4	-0.4	0.2		0
Surrogate Recovery	%Recovery	14	14	0	83	99	94		0
Total Petroleum Hydrocarbons	mg/L	12	0	12	-0.5	-0.5	0.25		0
Sulfide		9	0	9	-1	-1	0.5		0

- 1) Water quality criteria are reported in $\mu\text{g}/\text{L}$. Values of mC and bC are constants specific for each analyte. CF is the conversion factor to calculate water quality concentrations for dissolved analyses from total analyses. Hardness is equal to $[2.497 * (\text{Ca}, \text{mg/l}) + 4.118 * (\text{Mg}, \text{mg/l})]$ expressed in mg/l as CaCO₃.
- 2) National Recommended Water Quality Criteria for Non Priority Pollutants.
- 3) Average concentrations use one half the detection limits for analyses reported as below the MDL.
- 4) No ammonia water quality standards were calculated owing to the lack of adequate surface water flow data as required for the chronic criterion (CCC) as specified in the 1999 Update of the Ambient Water Quality Criteria for Ammonia.

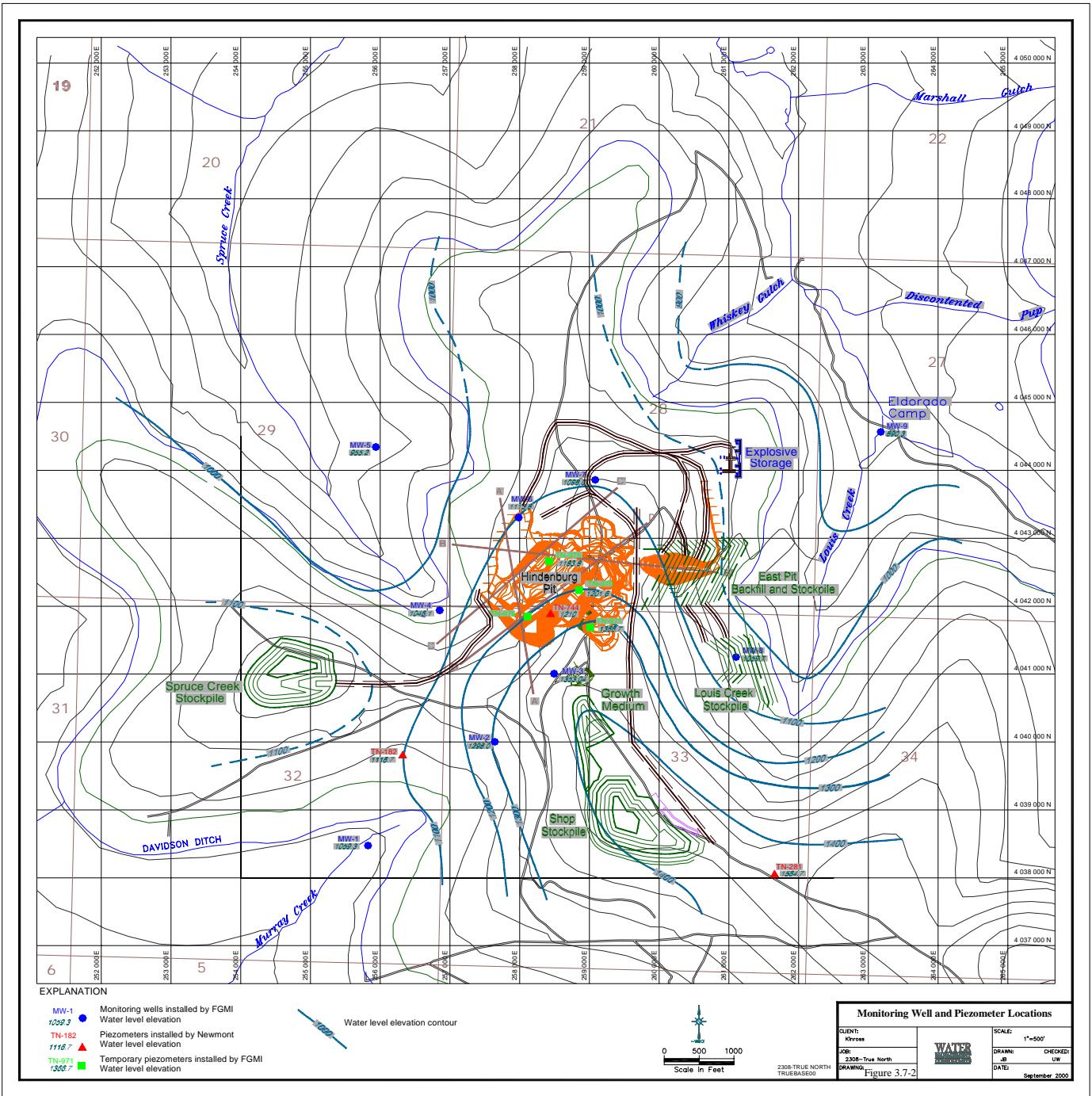


Table 3.7-4
Summary of groundwater sampling events

Location interval	Completion	Sampling events	Number
			of events
TN-182	183.7-223.7	11/9/94, 10/20/95, 9/12/96, 12/23/97, 9/29/98	5
TN-281	185.7-215.7	11/9/94, 10/23/95, 9/12/96, 12/22/97	4
TN-672	na	1/22/98	1
TMW-2	250.2-270.2 290.2-330.2	2/2/00 ⁽¹⁾	1
TMW-3	295.7-315.6 335.5-355.4	2/2/00 ⁽¹⁾	1
TMW-6	251-271 291-311 331-351	2/2/00 ⁽¹⁾	1
TMW-7	423.1-463.1	2/2/00 ⁽¹⁾	1
TMW-8	226.5-246.5 266.4-306.2	2/2/00 ⁽¹⁾	1
TMW-9	37.9-57.8	2/2/00 ⁽¹⁾	1
Total			16

⁽¹⁾ Samples collected by FGMI

As with the surface water chemistry, two types of groundwater are present in the True North project area. Water samples from MW-6, MW-7, and TN-182 were calcium sulfate type water. The remaining water samples were calcium carbonate type groundwater. Figure 3.7-3 is a trilinear diagram showing the major element chemistry of the water samples from the monitoring wells and piezometers. The data used to develop Figure 3.7-3 includes the average groundwater chemistry for samples collected from monitoring wells TN-182 and TN-281. Figure 3.7-4 shows the sulfate concentrations in the groundwater samples from the project area. Table 3.7-5 summarizes the results of the average analyses for TN-182 and TN-281 as well as the single analyses for all other samples.

Calcium sulfate type groundwater samples were obtained from monitoring wells located along the trend of the mineralization in areas of proposed mining. The three analyses reported in Table 3.7-5 (wells TN-182, MW-6 and MW-7) record elevated concentrations of calcium, magnesium, manganese (MW-6 and MW-7),

potassium, sodium (MW-6 and MW-7), sulfate, TDS, and TSS compared with calcium carbonate type groundwater samples. Total iron concentrations were high in MW-6 and MW-7, and the three Newmont samples (TN-182, TN-281, and TN-672). Chloride was exceptionally high in the single sample from MW-7.

Groundwater chemistry and groundwater quality standards

Groundwater within the State of Alaska is protected for use class as Class (1)(A) (fresh water, water supply). As such, water quality standards are defined at 40 CFR 131.36 for human health criteria for priority and non-priority pollutants and, by reference, 40 CFR 141 for safe drinking water standards. Table 3.7-6 summarizes the results of all of the surface water chemical analyses and includes the number of reported analyses, the number of samples with detected concentrations, the number of analyses below the MDL, the minimum concentrations, the maximum concentrations, and the average concentrations. The average concentration uses one half the detection limit for values reported as below the MDL.

Table 3.7-6 also includes the EPA drinking water standards (EPA, 1998) and the EPA human health criteria for priority and non priority pollutants. The minimum concentration for either the drinking water quality standards or the human health criteria was used to estimate the number of exceedences, which also are shown in Table 3.7-6.

One or more samples exceed the minimum water quality standard for antimony, arsenic, iron, manganese, sulfate, and TDS. All five of the analyses recording antimony concentrations above 0.006 mg/l occurred within historic samples (TN-182 with four exceedences and TN-672 with one exceedence). The elevated antimony concentrations do not appear to be spatially associated with the zone of elevated sulfate concentrations. Concentrations of arsenic exceed the human health standard (0.018 µg/l or 0.000018 mg/l) for all of the samples analyzed including those reported as below the MDL, because the standard is less than the minimum MDL. All of the samples from TN-182, TN 672, and MW-3 exceed the MCL (0.05 mg/l), but again these samples are not restricted to the zone of

higher sulfate concentrations. Three samples exceed the secondary standard for iron, including single samples from TN-672, MW-3, and MW-9. All of the wells recorded at least one sample with TDS above the human health criteria of 250 mg/l.

Eleven samples recorded manganese concentrations that exceed the human health criteria of 0.05 mg/l, including four samples from TN-182, two samples from TN-281, and single samples from TN-672, MW-3, MW-6, MW-7, and MW-9. Since the maximum manganese concentrations occur in samples from MW-6 and MW-7 (1.79 and 1.93 mg/l respectively), the elevated manganese concentrations in the outlying hole may reflect the presence of a peripheral mineralized halo around the ore-body. All seven elevated sulfate concentrations (above 250 mg/l) were from groundwater samples collected from TN-182, MW-6, and MW-7, the calcium sulfate type water samples.

Figure 3.7-3 Trilinear plot based on groundwater samples

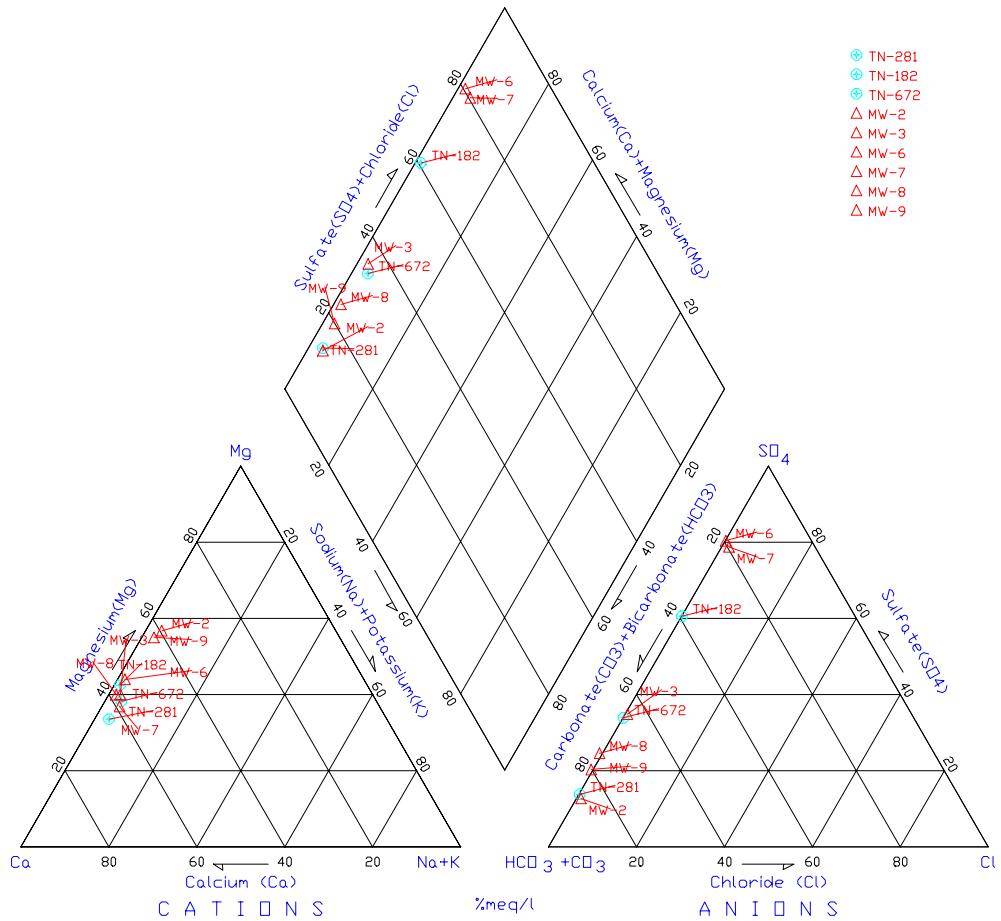


Figure 3.7-4 Sulfate concentrations from baseline groundwater samples

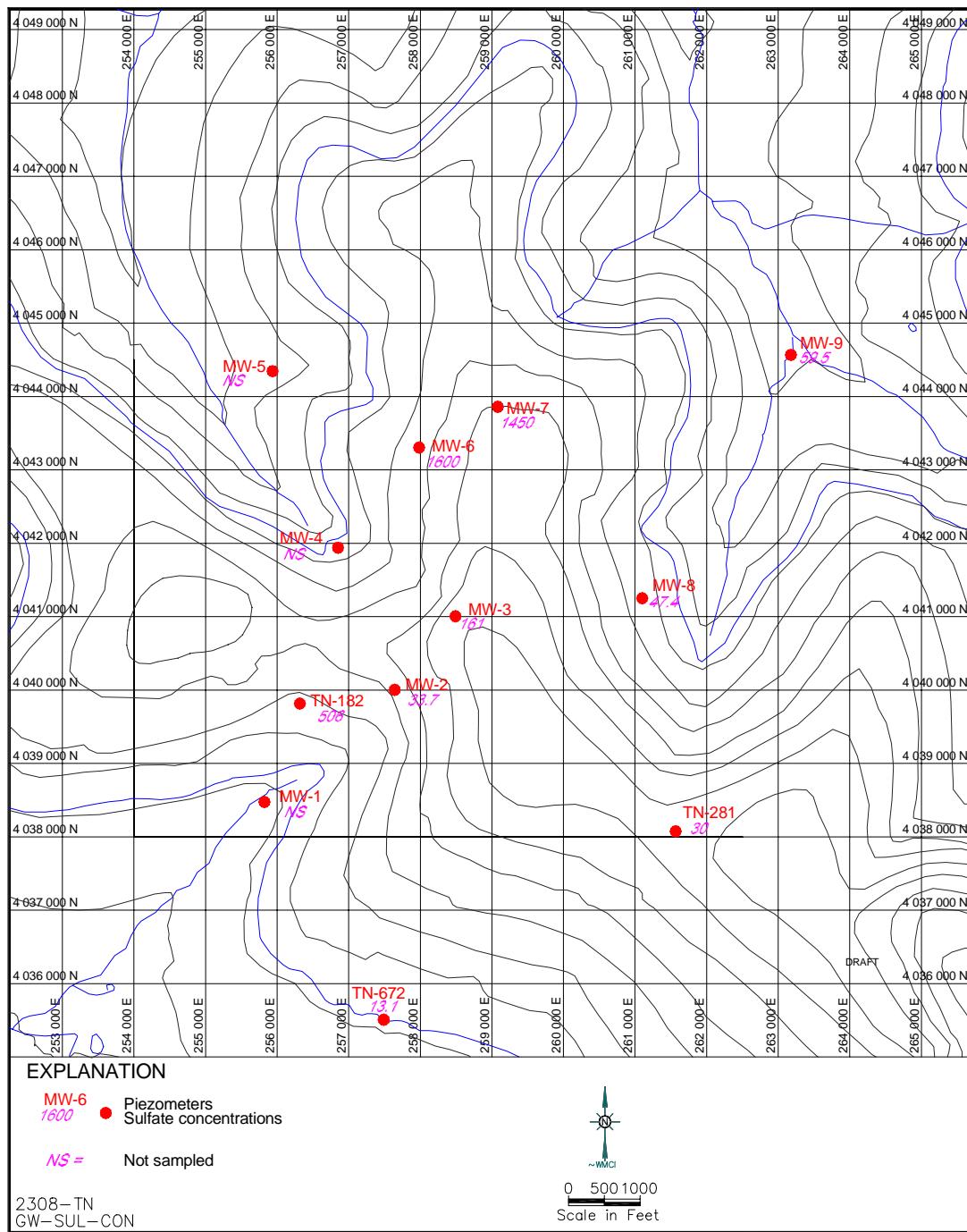


Table 3.7-5 Average groundwater chemistry for nine wells

Well		TN-281	TN-182	TN-672	MW-2	MW-3	MW-6	MW-7	MW-8	MW-9
Number of samples		4	5	1	1	1	1	1	1	1
Alkalinity as CaCO ₅	mg/L	198	343	265	238	311	405	376	153	244
Ammonia-N	mg/L	0.50	0.46	1	-0.05	0.14	0.09	-0.05	-0.05	-0.05
Antimony	mg/L	0.004	0.008	0.031	0.0017	0.0038	-0.0013	0.0028	-0.0013	0.0013
Antimony	mg/L	0.092	0.044	0.033	0.0028	0.0053	-0.0013	0.0022	-0.0013	0.0037
Arsenic	mg/L	0.029	0.149	0.415	0.008	0.43	-0.005	0.008	0.015	0.041
Arsenic	mg/L	0.438	0.470	0.533	0.015	0.414	0.052	0.015	0.015	0.046
Barium	mg/L	0.022	0.014	0.119	0.019	0.012	0.013	0.013	-0.005	0.025
Barium	mg/L	0.410	0.110	0.158	0.022	0.013	0.033	0.016	-0.005	0.029
Bismuth	mg/L	0.05	0.09	-0.1	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Bismuth	mg/L	0.14	0.09	-0.1	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Cadmium	mg/L	0.0001	0.0001	-0.0001	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005
Cadmium	mg/L	0.0002	0.0002	0.0002	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005
Calcium	mg/L	55	201	87	43.4	109	463	474	46	51.2
Calcium	mg/L	81	211	95.2	37.6	100	452	476	39.7	51.2
Calcium Hardness	mg/L	NS	NS	NS	263	0	2090	1920	194	294
Chloride	mg/L	0.3	0.3	0.3	1.9	1.8	1.5	22.3	-1	-1
Chromium	mg/L	0.001	0.001	-0.002	-0.005	-0.005	0.009	-0.005	-0.005	-0.005
Chromium	mg/L	0.041	0.029	0.012	-0.005	-0.005	0.02	0.014	-0.005	-0.005
Conductance	umhos	430	1367	870	482	828	2880	2810	373	533
Copper	mg/L	0.006	0.004	-0.005	-0.01	-0.01	-0.01	-0.01	0.02	-0.01
Copper	mg/L	0.089	0.027	-0.006	-0.01	0.01	0.02	-0.01	-0.01	-0.01
Cyanate	mg/L	0.005	0.005	NS						
Cyanide, Total	mg/L	0.01	0.01	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cyanide, WAD	mg/L	0.01	0.01	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Field temperature	Deg C	NS	NS	NS	-1	0	1	-2	0	-1
Fluoride	mg/L	0.15	0.40	0.12	1.3	1.3	0.14	-0.05	0.13	-0.05
Hydrogen Sulfide	mg/L	NS	NS	NS	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Iron	mg/L	0.04	0.02	1.51	-0.03	0.83	-0.03	0.3	-0.03	0.85
Iron	mg/L	43.4	10.8	3	0.003	0.95	3.08	2.02	0.04	3.26
Lead	mg/L	0.002	0.001	-0.002	0.002	-0.002	-0.002	-0.002	-0.002	-0.002
Lead	mg/L	0.086	0.016	-0.002	0.003	-0.002	0.003	-0.002	-0.002	-0.002
Magnesium	mg/L	17.7	91.8	34.8	37.7	46.2	227	179	19.1	40.4
Magnesium	mg/L	28.8	95.0	37.1	38.8	45.7	229	182	18.6	40
Manganese	mg/L	0.103	0.094	0.312	0.034	0.712	1.79	1.93	0.029	0.159
Manganese	mg/L	0.920	0.209	0.288	0.036	0.719	1.9	1.85	0.023	NS

NS = Not sampled

Table 3.7-5 Average groundwater chemistry for nine wells (continued)

Well		TN-281	TN-182	TN-672	MW-2	MW-3	MW-6	MW-7	MW-8	MW-9
Number of samples		4	5	1	1	1	1	1	1	1
Mercurv	ma/L	0.0001	0.0001	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
Mercurv	ma/L	0.0001	0.0001	0.0003	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
Nickel	ma/L	0.013	0.010	0.013	NS	NS	NS	NS	NS	NS
Nickel	ma/L	0.018	0.038	0.013	NS	NS	NS	NS	NS	NS
Nitrate-N	ma/L	0.07	0.03	-0.03	0.07	-0.01	0.03	-0.01	0.33	0.08
Nitrite-N	ma/L	0.02	0.03	-0.03	0.02	-0.01	-0.01	-0.01	-0.01	-0.01
pH	Unit	7.5	7.3	7.4	7.7	7.3	7.3	7.2	7.4	7.7
Potassium	ma/L	1.9	6.2	4	2.9	5.1	16.2	16.8	-1	1.9
Potassium	ma/L	14.3	8.6	4.85	2.7	4.9	17.7	17.1	-1	1.8
Selenium	ma/L	0.002	0.005	-0.003	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
Selenium	ma/L	0.003	0.008	-0.003	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
Silicon	ma/L	3.1	4.4	6.8	2.5	5.3	5.5	7.2	3	4.5
Silicon	ma/L	198.1	21.3	10.2	2.4	5.2	9	8.4	3.1	5.2
Silver	ma/L	0.0001	0.0002	0.0001	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Silver	ma/L	0.0004	0.0002	0.0001	-0.01	0.01	-0.01	-0.01	-0.01	-0.01
Sodium	ma/L	2.18	1.61	4.12	2.9	2.6	6.8	26.7	2.1	2.7
Sodium	ma/L	3.25	1.82	4.32	2.6	2.2	7.4	23.1	2.3	2.5
Sulfate	ma/L	30	506	131	33.7	161	1600	1450	47.4	59.5
Total Dissolved Solids	ma/L	251	1088	449	330	630	2930	2770	300	390
Total Phosphate-P	ma/L	0.19	0.43	0.37	-0.05	-0.05	0.09	-0.05	-0.05	-0.05
Total Solids	ma/L	1137	1325	500	NS	NS	NS	NS	NS	NS
Total Suspended Solids	ma/L	1020	224	34	-5	-5	112	61	-5	31
Turbidity	NTU	333	84	12	NS	NS	NS	NS	NS	NS
Zinc	ma/L	0.033	0.007	-0.008	-0.01	0.02	0.06	0.04	-0.01	-0.01
Zinc	ma/L	0.082	0.044	0.011	-0.01	0.02	0.08	0.04	-0.01	-0.01
Benzene	ua/L	0.1	0.1	NS						
Chlorobenzene	ua/L	0.1	0.1	NS						
1,2-Dichlorobenzene	ua/L	0.1	0.1	NS						
1,3-Dichlorobenzene	ua/L	0.1	0.1	NS						
1,4-Dichlorobenzene	ua/L	0.1	0.1	NS						
Ethvlbenzene	ua/L	0.1	0.1	NS						
Toluene	ua/L	0.15	0.295	NS						
Xylenes	ua/L	0.2	0.425	NS						
Surrogate Recoverv	%Recover	98	102	NS						
Total Petroleum	ma/L	0.2	0.2	NS	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5

NS = Not sampled